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NASA-16725 (September 1999)
NATIONAL AERONAUTICS **NASA - KSC**
AND SPACE ADMINISTRATION **Superseding NASA-16741**
(September 1996)

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DIVISION 16 - ELECTRICAL

SECTION 16725

AUDIO CABLE SYSTEMS

09/99

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SECTION 16725

AUDIO CABLE SYSTEMS
09/99

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NOTE: Delete, revise, or add to the text in this section to cover project requirements. Notes are for designer information and will not appear in the final project specification.

This section covers the requirements for audio pair telephone cable to be installed. Associated components for this system shall include splice connectors and splice cases.

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PART 1 GENERAL

1.1 REFERENCES

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NOTE: The following references should not be manually edited except to add new references. References not used in the text will automatically be deleted from this section of the project specification.

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The publications listed below form a part of this section to the extent referenced:

RURAL ELECTRIFICATION ADMINISTRATION (REA)

REA PE 89	(Oct 1985) Filled Telephone Cable with Expanded Insulation

U.S. AIR FORCE TECHNICAL ORDERS (TO)

TO 31W3-10-12	(1986) AF Communications Service Standard Installation Practices, Outside Plant Cable Placement
TO 31W3-10-13	(1980; CHG 5 1986) AF Communications Service Standard Installation Practices, Outside Plant Cable Splicing

1.2 GENERAL REQUIREMENTS

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NOTE: If section 16003, "General Electrical Provisions," is not included in the project specification, applicable requirements therefrom should be inserted and the following paragraph deleted.
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Section 16003, "General Electrical Provisions," applies to work specified in this section.

1.3 SUBMITTALS

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NOTE: Review submittal description (SD) definitions in Section 01330, "Submittals," and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control. Include a columnar list of appropriate products and tests beneath each submittal description.
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The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Manufacturer's catalog data shall be submitted for the following items. Data shall include a complete list of parts, special tools, and supplies with current unit prices and source of supply.

Lubricant
Cable
Splice Connectors
Splice Cases
Connector Blocks
Protection Modules
Terminal Blocks
Spares, Tools, and Equipment

SD-06 Test Reports

Test reports shall be submitted for the following tests in accordance with the paragraph entitled, "Testing Audio Cable," of this section. A test plan that includes detailed step-by-step

procedures for the cable field test required by this specification and the calibration details for test instruments shall be submitted for approval a minimum of 30 days prior to any cable testing.

Insulation Resistance Tests
Section Tests
Loop Resistance Tests

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals shall be submitted for the following items in accordance with paragraph entitled, "Operation and Maintenance," of this section.

Splice Connectors
Central Office Connector
Protection Modules

1.4 AUDIO CABLE IDENTIFICATION

The first two lines on the ID symbol employee the following four characters:

First Character - Shall denote the number of hundred pair groups of audio pairs in the cable.

Second Character - Shall be a dash.

Third and Fourth Characters - Shall denote the gauge of the audio wire.

The second line of the cable ID symbol indicates the conductors are audio type cable, number and pair count.

Example: 6-22 Identifies a 600 pair 22 gage audio cable CA 12:1400-2000 No. 12 with pair count 1401-2000. 2 millimeter diameter (No. 12).

PART 2 PRODUCTS

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NOTE: Designer must provide under this section a complete list of cable and connector types, including application specifications, that are used on the job and a complete list of cable and harness assembly fabrication drawings and procedures if applicable.

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2.1 TRAINING

Contractor shall provide a training course at KSC. Course shall consist of, but not be limited to, training in splicing, connectorization, and testing.

2.2 CABLE

All Audio Cable shall be [REA PE 89] [_____] type Filled Cable.

2.3 SPLICE CONNECTORS

Splicing shall be accomplished utilizing individual compression connectors [AMP Picabond No. 60947-3] [strip assembly No. 60954-4] [_____] or equal in accordance with TO 31W3-10-13, Section 3. All unspliced pairs shall be cleared and capped using [Scotchlock Brand UCC connectors] [_____] or equal.

Central office connector shall meet referenced standards within this section.

2.4 SPLICE CASES

Splice cases shall be of the [Preformed Line Products] [_____] reenterable stainless steel type, or equal with filling holes. Case size depends on cable size. Splice case shall be suitable for reentry without damage to the cable or splice. After completing the splice, all cases shall be totally filled with a reenterable encapsulating compound; [3M's Gella 4441] [_____] or equal.

2.5 CONNECTOR BLOCKS

Connector blocks shall be [Reliable Electric's Part No. R39922A 40D] [_____] or approved equal.

2.6 PROTECTION MODULES

Protection modules shall be [Reliable Electric's Part No. 6A 20] [_____] or approved equal.

2.7 TERMINAL BLOCKS

Terminal blocks shall be [8 by 26] [_____] blocks manufactured by [Reliable Electric] [_____] or approved equal.

2.8 SPARES, TOOLS, AND EQUIPMENT

One continuous length of the longest ordered/manufactured amount of each size of audio cable shall be placed on a standard reel and turned over to the Contracting Officer.

One complete set and all furnished manufacturer's data on all tools, equipment and miscellaneous materials of unusual nature or peculiar to this cable installation other than test equipment shall be furnished to the Contracting Officer.

PART 3 EXECUTION

3.1 PERSONNEL QUALIFICATIONS

Cable construction work shall be performed by construction personnel who

have had at least 3 years experience in placing cables in conduit, cable trays, and underground duct systems.

Audio cable splices shall be made by journeymen cable splicers who have had a minimum of 5 years experience in splicing and terminating communication cables.

Each individual who is to perform cable splicing may be required to perform a minimum of one acceptable sample splice of each type of cable to be spliced. Each individual may be required to demonstrate fundamental knowledge of cabling in manholes, ducts and cable racks and demonstrate fundamental knowledge of support and arrangement of cables. Sample splices shall not be incorporated in the job.

Contractor shall give a school of instruction in the presence of the Contracting Officer, or his designated representative, to all individuals who are to perform cable construction and splicing work on this job. This school shall consist of a careful and detailed review of construction techniques and splicing work according to the various procedures specified for use on this job. This school shall consist of a minimum of 4 hours of instruction. Instructors of this school shall be well qualified and shall have had a minimum of 5 years experience in the installation and splicing of the type of cable on which they are performing the instruction. A complete instruction course outline plus the certification of the qualifications of the instructors shall be submitted to the Contracting Officer for approval no later than 30 days prior to the time that the school of instruction is to begin.

3.2 WORK IN MANHOLES AND CABLE VAULTS

Contractor shall be responsible for ensuring that safe operating procedures are followed, work equipment is adequate, and personnel have received proper training. All atmospheric tests will be conducted by others prior to Contractor personnel entering a manhole or vault. Safety equipment will be inspected and approved by an authorized representative of the Contracting Officer.

Smoking shall not be permitted in or around open manholes.

Open manholes shall be protected by fences, railings, signs, flags, or lights, as applicable. Body static electricity that may have accumulated shall be discharged to ground prior to personnel contact with manhole covers. Removal of manhole covers shall be performed by two men using hooks and employing proper lifting techniques. All manhole covers in the immediate vicinity of the duct system where work is to be performed shall be removed to permit adequate ventilation.

A burn permit authorizing the use of torches, furnaces, or other open flame, heat-generating devices shall be obtained prior to use of such devices (use shall not be permitted in manholes).

Each time work is begun, excessive water shall be removed or pumped from the manhole vault or duct run, as required, prior to personnel entrance.

A manhole entry permit shall be required for every manhole entry. This permit will be issued by EG&G Environmental Health.

Vapor tests shall be performed to ensure that the presence of explosive gases is below dangerous concentration levels (less than 25 percent by volume).

Above environmental tests shall be performed each time work is started or at the initial crew change and shall be repeated in a time interval not to exceed 8 hours. If prolonged forced ventilation is required, the time interval for additional tests shall not exceed 2 hours.

Two persons shall be present during manhole operations: one man enters the manhole, the other shall remain outside. Outside man shall be equipped with a communication device to call for help if necessary.

If environmental tests indicate atmosphere is not safe, blowers or ejectors shall be used to clear all manholes or cable vaults of vapors, fumes, and gases to a safe level.

Blowers shall be operated continuously while work is being performed and until work is completed.

Blowers shall not be placed in the manhole or cable vault but shall be located on the surface at a distance not less than 5 feet 1500 millimeter from the open manhole or cable vault to assure a safe operating atmosphere. Engine driven equipment shall be located downwind from manholes and shall have ducted exhausts away from manhole opening.

Ladders of the proper length and type (wood or fiberglass) shall be used for entry into manholes.

Contractor shall locate all engine driven equipment downwind from manholes.

3.3 UNDERGROUND CONDUIT

The [4] [_____] duct or conduit assignment for individual cables shall be as indicated. Cables shall not be placed in ducts or conduits other than those indicated.

Assigned duct shall be rodded, cleaned, and tested for alignment as specified in TO 31W3-10-12. Mechanical equipment with which lines shall be used at both ends of the section to be rodded which will work the line back and forth through the ducts. The KSC duct system does not contain pulling lines and may contain orangeburg material. Some sections may require mechanical rodding equipment with cutting tools and water pressure equipment to clean and align the defective or blocked orangeburg duct as necessary.

3.4 CABLE PLACEMENT

Adequate care shall be exercised when handling and storing reels of cable to prevent damage to the cable. Cable with dents, flat spots, or other sheath distortions shall not be installed.

3.4.1 Securing Cable

Immediately after cable placement, temporary tags with the cable number and pair count shall be attached to each end of each cable section.

Cables and equipment shall be supported and secured. Where the specific method of support is not shown, adequate supports and fasteners shall be used to secure cables and equipment in position. Metallic supports and fasteners shall have a corrosion-resistant finish. All cables and equipment installed in exterior locations shall be secured so that they cannot be dislodged or damaged by winds up to 125 miles 200 kilometer per hour.

Cables splices shall be housed in a splice case installed along the cable route, mounted in the duct system cable vaults and manholes. Splice case shall provide a protected environment for the splices and shall maintain the moisture barrier properties of the cable. Cable splices in duct or conduit sections are prohibited.

3.4.2 Bending

Caution shall be used when bending cable to avoid kinks or other damage to the sheath. Bend radius shall be as large as possible with a minimum of not less than 10 times the O.D. of the cable. Minimum radii shall be increased when necessary to meet cable manufacturer's recommendations. Bending operations in manholes and vaults shall be performed in accordance with the procedures and instructions of the manufacturer. Cable bending shoes shall be used at duct or conduit ends when bending cable exiting a duct or conduit. Bending shoes shall remain in place until racking, splicing, and tying is completed. Cables shall not rest against the edge of the duct or conduit mouth.

Number of unspliced cable ends in a manhole, vault, or terminal room shall not exceed eight ends in manholes or four ends in vaults or terminal rooms. When a larger number of cables is to be placed, the cables shall be pulled, racked, and spliced or terminated in an order that will not exceed the above limitation. End slack in excess of that needed to properly rack and splice or terminate the cables shall not be pulled in manholes or vaults. End slack should provide 4 to 5 feet 1200 to 1500 millimeter of overlap for splicing.

3.4.3 Pulling

When a duct or conduit has an appreciable curve, and conditions permit, the cable reel shall be set up at the end nearest the bend and the cable pulled from the opposite end. Otherwise, the cable may be pulled from the most convenient end.

Pulling lines shall be attached to cable ends fitted with factory-installed pulling eyes. Cables not equipped with a pulling eye shall have the pulling line attached to the cable end by means of a cable grip. Core hitches shall not be used.

Rigging shall be set up at the pulling end so that the pulling line and cable enter or exit on a line parallel with the duct or conduit to prevent either from rubbing against the edge or mouth. Cable ends shall not be pulled around sheave wheels. When the end slack for proper racking and splicing with the pulling line attached to the end of the cable, a split cable grip may be used to obtain the necessary slack.

3.4.4 Set Up

Cable reels shall be located and aligned so that the cable is payed off the top of the reel into the duct or conduit in a long, smooth bend without twisting. Cable shall not be pulled from the bottom of a reel or subjected to reverse bends from those formed by factory reeling. A cable feeder guide of proper size shall be used at the mouth entrance. Unterminated cables shall be laid in the specified routing and location as indicated. Unterminated cable ends shall be cleared, capped, and sealed. Lubricant shall be compatible with, and intended for use with, Stalpeth sheathed cables. Soap and grease lubricants are prohibited.

All equipment and the pulling setup shall be carefully checked to minimize interruptions once pulling begins. Insofar as possible, the cable shall be pulled without stopping until the required amount of cable has been placed. If for any reason the pulling operation must be halted before the pull is complete, the tension of the pulling line shall not be released. When pulling is resumed, the inertia of the cable shall be overcome by increasing the tension in small steps a few seconds apart until the cable is in motion. Cable shall be payed off the reel by rotating the reel in the feed direction and not stripped off the reel by pulling.

3.4.5 Damage

Cable shall be carefully inspected for sheath defects or other irregularities as it is payed off the reel. If defects are detected, pulling shall stop immediately and the cable section shall be repaired or replaced at the discretion of the Contracting Officer. A system of communications, visual or otherwise, shall be maintained between feed and pulling locations so that pulling can be stopped instantly, if necessary.

"Pull-throughs" (continuous cable through two or more duct sections without splicing in an intermediate manhole) may be made with the approval of the Contracting Officer. Appropriate size split grip, manhole sheaves, sheave shackles and increased lubricant shall be used as well as exercising caution during the pulling operation to avoid excess slack and prevent kinking or any damage to the cable. Cables in the intermediate manhole shall be suitably racked at the time of installation with no sheath defects or other irregularities.

Cable ends pulled into manholes or vaults that are not to be racked or otherwise permanently positioned, shall immediately be tied in fixed positions with ties to prevent damage to the cables and to provide adequate working space. After final racking and splicing, plastic sheathed cables in manholes and vaults shall be secured in place with lashed cable supports. When securing cables and details are not indicated, the cables shall be secured in a manner that will maintain the cables in the required

position without damage to the cables.

3.5 CABLE SPLICING

Cables shall be spliced in accordance with the manufacturer's approved procedures.

Conductors shall remain in their correct color groups or unit.

Unterminated cables shall be installed as indicated. Unterminated or dead cable pairs shall be connected through to other unterminated or dead cable pairs, cleared at each end and tested according to other portions of this specification.

3.6 BONDING AND GROUNDING SYSTEMS

Cables shall be grounded as specified in Section 16062, "Grounding and Bonding for Secure Areas and Systems." Overall shield of all cables installed shall be grounded at each terminal point or bonded across all splice points and to a manhole bonding ribbon.

3.7 CABLE TERMINATIONS

Terminate cables as shown on contract drawings. Installation shall not impede future installations and shall not damage existing.

3.8 TESTING AUDIO CABLES

Electrical acceptance testing for cables under this specification shall be in accordance with TO 31W3-10-15. Field tests shall be witnessed by the Government. Five working days notice prior to performing each test shall be given. Measured electrical parameter shall conform to the manufacture stated specification. Sample forms included at the end of this section may be used. Test forms and procedures shall be included in the test plan. All test anomalies shall be corrected.

3.8.1 Test Equipment

Test equipment shall be of sufficient accuracy, quality, and quantity to perform specified tests.

Insulation resistance tests shall be performed with a 500-volt insulation resistance test set.

Use of auxiliary test boards, panels, or other special equipment to facilitate the testing procedure is optional, subject to approval. Equipment shall not cause any appreciable change in the actual cable measurements being made and shall be designed to permit ready verification of the internal circuits and components.

All test equipment shall be calibrated by a certified testing company every 80 days unless required sooner because of damage or inaccuracy. Standards for calibrating shall be as listed by the National Bureau of Standards, and each item of test equipment shall display a current calibration sticker.

3.8.2 Section Tests

End-to-end tests for shorts, crosses, opens, grounds, splits and transpositions shall be made and each conductor condition recorded separately.

3.8.3 Loop Resistance Tests

Loop resistance tests of each pair shall be made and recorded.

3.8.4 Insulation Resistance Tests

End-to-end test of each conductor to all other conductors and all conductors to ground (shield) shall be made and recorded.

3.9 OPERATION AND MAINTENANCE

Contractor shall submit [6] [_____] copies of the Operation and Maintenance Manuals for the following items. Data shall be updated and resubmitted for final approval no later than 30 days prior to contract completion.

Operation and maintenance manuals shall be consistent with manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions. Test data shall be legible and of good quality. Light-sensitive reproduction techniques are acceptable provided finished pages are clear, legible, and not subject to fading. Pages for vendor data and manuals shall have 3/8-inch 9.5 millimeter holes and be bound in 3-ring, loose-leaf binders. Data shall be organized by separate index and tabbed sheets, in a loose-leaf binder. Binder shall lie flat with printed sheets that are easy to read. Caution and warning indications shall be clearly labeled.

Contractor shall provide classroom and field instructions in operation and maintenance of systems equipment where required by the technical provisions. These services shall be directed by the Contractor, using the manufacturer's factory-trained personnel or qualified representatives. Contracting Officer shall be given 7 days written notice of scheduled instructional services. Instructional materials belonging to the manufacturer or vendor (e.g., lists, static exhibits, visual aids) shall be made available to the Contracting Officer.

-- End of Section --